

INVITED LECTURE T6

Coherent anti-stokes raman scattering microscopy

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Coherent anti-Stokes Raman scattering (CARS) microscopy is a vibrational imaging technique developed over the last several years. It is the result of a marriage between traditional spectroscopy wisdom and modern microscopy technology. Using two excitation lasers at different frequencies, the anti-Stokes signal from 3rd-order frequency-mixing is significantly enhanced when the excitation lasers are tuned to resonance with an active Raman band. Therefore CARS microscopy offers molecular selectivity without the need for labeling. Additional advantages come from the nonlinear and coherent nature of CARS, which boost the signal level to 10⁸ times higher than the signal in confocal Raman microscopy for most samples. Such high signal level enables fast imaging speed up to video rate. The nonlinear dependence on laser intensity also provides sub-micron 3D spatial resolution from tightly focused excitation beams.

To demonstrate the unique advantages of CARS microscopy, a few biomedical applications including membrane imaging, drug imaging and neuroimaging will be introduced. On the other hand, we will also discuss the current limitations of CARS microscopy. The future developments of CARS microscopy will aim at overcoming these limitations and expanding the potential of this technique for a broader range of applications.